Muzzleloader Lab, 2nd Edition


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SONORAN DESERT INSTITUTE

SCHOOL OF FIREARMS TECHNOLOGY

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Objectives

Upon successfully completing this course, the student should be able to:

1. Understand the process of inletting metal parts into wood using transfer black, employing chisels and scrapers to achieve a proper fit.
2. Demonstrate the procedure of shaping wood, polishing brass, and custom-fitting metal parts to a wooden gunstock.
3. Test and operate the percussion lock on a muzzleloader.
4. Discuss the procedure of gunstock wood sanding, shaping, sealing, and finishing.
5. Demonstrate the procedure of rust browning a barrel, drifting sights, and other metal pieces.

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Lock, Stock and Brass Furniture

There's no excitement quite like your first gun-stocking project. At least that's true if you're a firearms enthusiast. This lab marks your start of developing hand skills working with metal and wood, and depending upon your dedication, can lead to discovering in yourself a desire to learn more and create objects of functional beauty.

The first thing you'll need to do upon opening the box is to lay out all the parts and identify each component, paying particular attention to the small parts and screws. Using Figure 2, lay everything out in its proper place to be sure all parts are included. It's a good idea to isolate all the small parts and label them by name or part number, making it easy to select the correct screw/part for each new step. Familiarize yourself with all the parts and understand their functions.

INLET THE LOCK

The stock inlets for the various component parts have been machined to a near fit. The edges of the inlets are delicate, and care must be taken to protect them as you work. With that in mind, we'll proceed to fit the parts in order of vulnerability, beginning with the percussion lock (Figure 3). First, familiarize yourself with the lock and the way it works. Pull back the hammer and note how the various parts move. Understanding how they move in relation to each other at different hammer positions will help you a lot as you are fitting metal to wood.

Use your small acid brush to put a *very small* amount of inletting black on just the surfaces that you'll be inletting (Figure 4). If you put it on too thick, it will result in your taking off too much wood, leaving unsightly gaps between wood and metal. It is usual to not need more inletting black than has been initially applied; just spread what you have each time you try to fit the part into its recess (Figures 5 through 8).

As you scrape the wood to remove the transfer black, the black remaining on the metal will become thinner each time you spread it with the brush, and this is just what you want. By the time you have fully inlet the part, you'll have a very thin coating and hopefully a near-perfect fit. Just keep trying to gently fit the part into its recess, tapping softly with a rawhide mallet, or if you don't have one, you can use a 4 in. length of ½ in. diameter wood dowel and the smallest hammer you can find with which to tap it. Go slowly, and expect to try-fit the part many times.

Figure 2: Traditions Parts Kit

For the OEM parts list and schematics, please refer to the Traditions Shenandoah Rifle Kit Instruction Content booklet in your additional resources.

Figure 3: Percussion lock assembly.

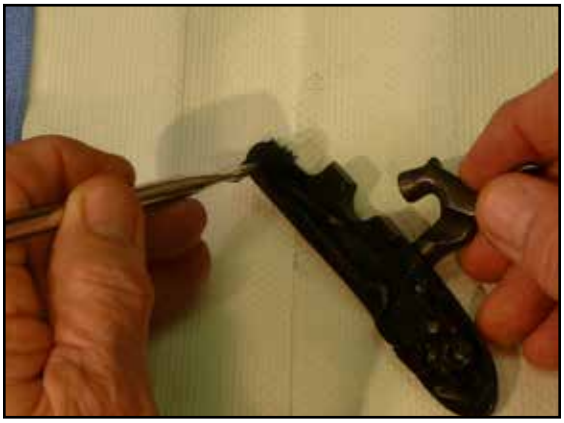

Figure 4: Brushing on the inletting black.

Figure 5: Initial fit. Notice the inletting black that has been transferred to the stock.

Figure 6: Use a small gouge in places where a scraper would be ineffective.

Figure 7: Expect to try the part many times until a proper fit is achieved.

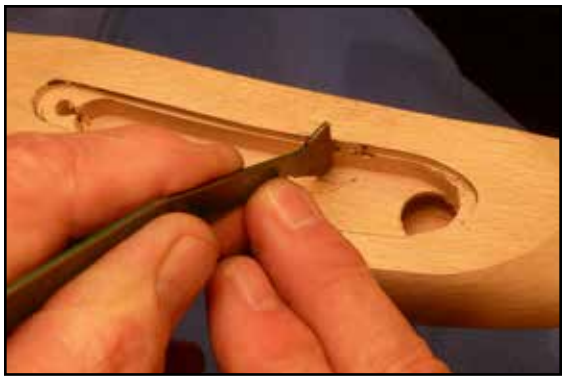

Figure 8: Using a scraper to remove wood.

Figure 10: Inspecting where moving parts contact the wood.

Figure 9: Tap gently from the opposite side to remove the lockplate.

During the final inletting of the lock it will go into place, but will be difficult to remove for further fitting, being still too tight. To ensure that you remove the part evenly without splitting the edges of the wood, put in the lockplate screws just a few turns and tap (Figure 9). When you are finished, if you have done a good job of inletting, you'll be able to remove the lock without force, with no binding, squeaking, or gaps. Now install the lockplate screws with their washers to keep it in place. Screw them in lightly, as you don't want to stress or crack the wood, which is easily done without the barrel in place.

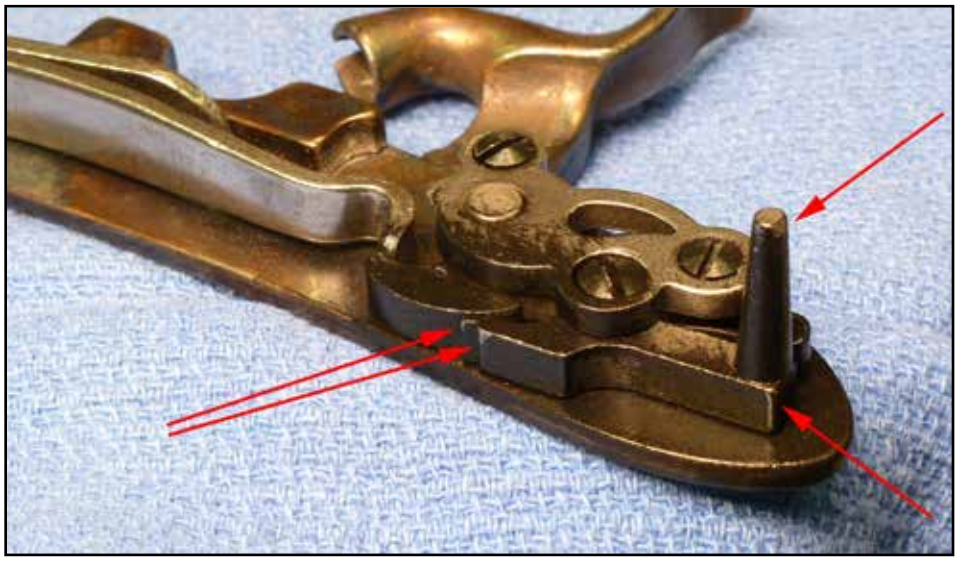

Figure 11: Areas of contact where wood needs to be relieved will show shiny spots on the metal as well.

Now pull the hammer back to half-cock to see that it catches. Chances are that it won't. As illustrated in Figures 5, 7, and 10, transfer black shows where the moving parts contact the wood. Carefully inspect the metal surfaces for signs of contact (Figure 11). The wood in these areas will need to be cleared in order for the parts to move freely. It may be necessary to undercut the inlet a bit, but if you need to do so, use caution as you don't want to open up unsightly gaps. Your round scraper was designed for this type of operation. When you've gotten half-cock functioning properly, work through the same process for the full-cock hammer position. When you get the lock inlet to your satisfaction, clean the metal of inletting black. Simple Green® brand cleaner and hot water work very well for this. Be sure to dry the parts thoroughly.

PRELIMINARY BRASS CLEAN-UP

The brass parts are castings, which have left mold seams and rough surfaces. Before we can begin to fit the wood and metal together, we'll need to do a preliminary clean-up. The brass is soft, so be careful not to remove too much metal by overworking it. Additionally, you must be very careful not to bend or break the parts as you clean them up.

Figure 13: Use needle files for the tight places.

Figure 14: Start with 150-grit sandpaper or shop roll and a pliable sanding block.

Figure 12: The first step is to remove the casting marks.

Figure 15:Continue with 180-grit sandpaper and work at a 90° angle to the sanding marks.

Figure 16: Finish preliminary cleanup with 220-grit sandpaper.

Selecting the trigger guard as an example, use your single-cut file to remove the mold seams (Figure 12). Stay away from the vertical edges, which will be inlet into the wood. These are pretty closely cut at the factory, and we don't want to remove any brass, or wood for that matter, until we see exactly what will need to be removed.

If you have access to needle files, they'll be a great help in the tight places (Figure 13). Next, using a strip of 150-grit shop roll, work the surface using strokes all in the same direction until the only scratches showing are the ones you're making. For these contoured surfaces, use a pliable backing or just your fingers as needed (Figures 14 and 15). Now go to 180-grit and do the same, working at a 90° angle to the marks you've just made.

That's the secret to metal polishing. With each finer grit you'll work at right angles to the marks in the metal until they disappear. You will probably have spots where you'll need to go back to the previous grit to clean up stubborn scratches or file marks, so just expect that. When the metal looks good after the 180 pass, then go to 220-grit, and that should do it for now (Figure 16).

You can do the preliminary clean-up on all the brass parts in advance, or just work them each in turn as you inlet them. Working it all at one time can become tedious. The one part that you won't work in advance is the rear thimble, and the reasons will be explained later.

Figure 17: Screw buttplate to a wooden board to stabilize it during the polishing process.

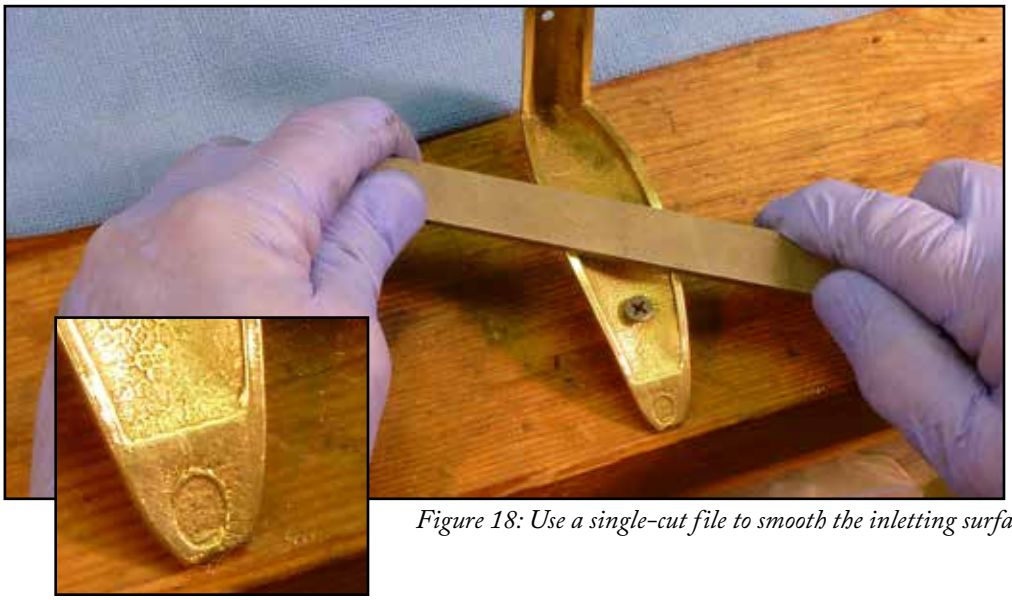

Figure 18: Use a single-cut file to smooth the inletting surfaces.

BUTTPLATE

The edges of the stock inlets at the butt are vulnerable to damage, so let's install the crescent-shaped buttplate next. You'll notice that the brass mating surfaces aren't smooth, so you'll need to true them up. The simplest way to handle this oddly shaped part for the filing process without damaging the outer surfaces in the vise is to screw it to a board from the inside, as shown in Figures 17 and 18. Use a single cut file, as the aggressiveness of a double-cut file will remove too much.

Because the brass is soft, it won't take much work at all to make the surfaces flat and true. Be sure to file out the casting marks on the flat at the underside of the toe line, as a clean surface in that area will be important in the next step. Take off no more metal than is necessary to true the surfaces. As you did with the lockplate, lightly coat all bearing surfaces with inletting black (Figure 19).

As you inlet, keep in mind that the direction you want to be going is roughly 45° to the top line of the butt, down and forward (Figure 20). This will work the metal into the wood evenly, going both forward and down at the same rate. Resist the temptation to put in the screws before the

Figure 19: Apply inletting black to the mating surfaces.

Figure 20: Maintain a 45° angle as you inlet both down and forward.

Figure 21: Checking the inletting black on the buttstock.

Figure 24: Scrape or shave away the high spots.

Figures 22: Scraping the edges of the buttstock.

Figure 25: Edges are still high in the inletting process; continue to work.

Figures 23: Scraping the edges of the buttstock.

Figure 26: A thin layer of black is spread throughout; time to set the brass buttplate.

Figure 27: Small clamps can help when transferring inletting black.

Figure 28: Proper drill alignment requires two people, one for each axis.

part is completely inlet, as doing so will result in a poor fit. Again, tap the metal softly to transfer the inletting black. After just a few cycles the part will begin to find its groove and will seat in the same place with each try. Figures 21 through 27 will give you an idea of how the work should go.

A necessary step when drilling the pilot holes for the screws is to first mark the wood at the center of the hole with a punch. If you don't, the bit will wander just a bit before biting into the wood and the pilot hole will be off-center. Select a drill bit of the approximate minor diameter of the shaft of the screw (Figures 28 and 29).

This will ensure that the wood won't split, but will allow the threads to cut themselves into the wood and do what they were designed to do. Applying a little wax to the threads will make things go a bit more smoothly (Figure 30).

It is important that the pilot holes for the screws be drilled at the correct angle. It will work best if you can get a second person involved — one of you for each axis. When both of you call the okay, drill. If you mess things up, there's an easy fix. Just drill out the wrongly placed hole a bit oversize and glue in a wood dowel of the same diameter, using 5-minute epoxy. The next day, when the epoxy has fully cured, just dress off the top to blend with the stock wood and you're ready to try again.

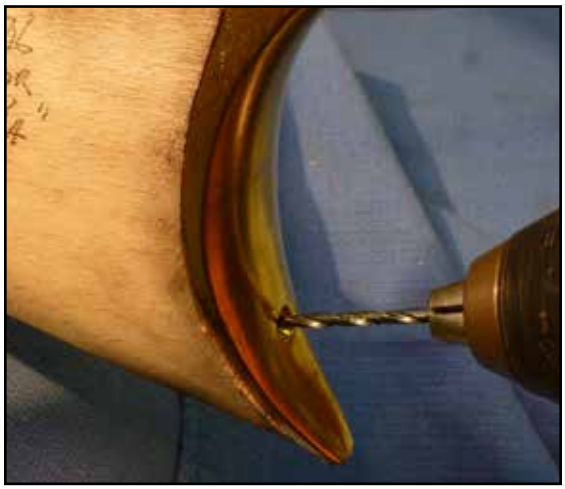

Figure 29: Drilling a pilot hole into the lower buttplate screw location.

Figure 30: Applying wax to the threads.

Figure 31: A new angle will be required for proper match-up.

Figure 34: Mark the stock.

Figure 32: Mark the angle of the toeplate.

Figure 35: Finish the inletting by scraping the transfer black, watching as the other end descends for a perfect fit.

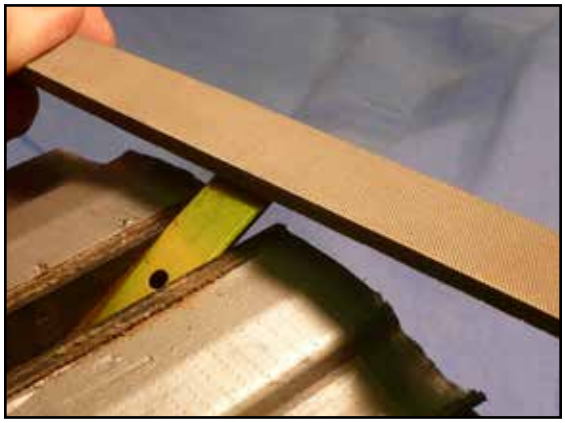

Figure 33: File the proper angle onto the toeplate.

Figure 36: Locate and drill pilot holes for the toeplate.

TOEPLATE

The fitting of the toeplate is next. You'll need to file the angle at one end to match the angle of the surface of the underside of the buttplate where it extends beyond the stock wood (Figure 31). Lay the toeplate on the flat of the stock as best you can; but since it is too long for the inlet provided, the other end will lie outside the stock line (Figure 32). That's okay, as we are just going to mark the angle we're going to file into it.

When you get the angle filed correctly (Figure 33), place the two brass surfaces together and mark a line on the gunstock wood along the other end of the plate (Figure 34). Use your inletting black again, and when you've removed the wood up to around 1/32 in. from the line you've marked (Figure 35), switch tactics and try the parts for fit by laying the squared and blackened end against the wood you're working, paying attention to whether the angled end is descending down into its proper place.

Bit-by-bit it will drop into place as you scrape or chisel the wood away at the other end, and by doing it this way you'll have less chance of removing too much wood. Again, drill pilot holes of the proper diameter for attaching the screws (Figures 36 and 37).

THIMBLES

Next, we'll install the rear thimble and the rear thimble screw. The reason we didn't do a preliminary clean-up of this part is that it is best to work the brass rather than the wood in this area. The wood inlets have been properly cut during manufacture, and it is the brass that is not quite the proper shape yet. Using a single-cut file again, carefully work the imperfect surfaces left by the casting process on the thimble's extension down to fit the wood inlets (Figure 38), and on the cylindrical body, work it to an approximate roundness to match the smooth surfaces of the brass (that don't need attention). It should be possible to work only the areas that will be hidden by the wood when the part is installed. If just a bit of the wood should need to be scraped for a proper fit, then that will be fine.

The reason the brass wasn't drilled during the manufacturing process is that the holes for the wood and the thimble will need to be drilled at the same time for proper fit. Clamp the thimble into place, ensuring that the wood surfaces are protected.

The size of the screw provided is M4-70 (metric), so finding and using a tap is not going to be convenient; but there's a simple way to tap the brass.

Figure 37: Carefully insert the stock screws.

Figure 38: Use a single-cut file to shape the brass thimble for proper fit into its inlet.

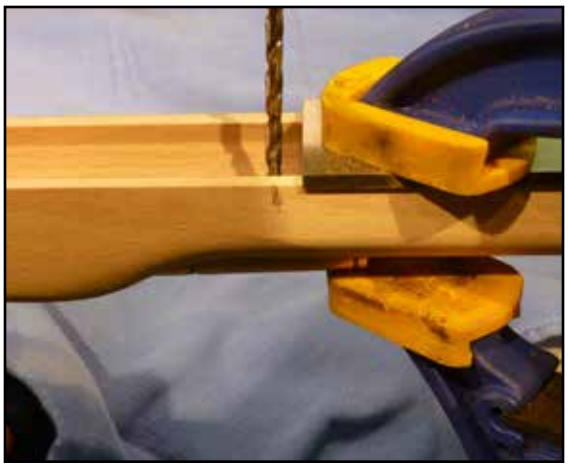

Figure 39: Drill an undersized pilot hole through the wood and brass, then use the screw to tap them at the same time.

Figure 40: Use a thin piece of wood to shorten small screws without damaging them.

Figure 41: Now it is easy to file the screw to proper length.

Mark a spot in the center of the barrel channel with your punch, and, using a slightly undersized bit, drill the wood and metal together (Figure 39). (HINT: Mark the edges of the facets of the barrel flats inlet with a pencil to make finding the visual center of the barrel channel much easier.) Be sure to stop the drill when you break through into the center of the thimble. Now, keeping the parts clamped, run the screw into the pilot hole. The threads will self-tap into the wood and brass in one smooth operation.

The last two steps are to countersink the head of the screw into the wood so it is level with the barrel channel, and to shorten the screw slightly so it won't interfere with the ramrod's travel through the thimble. NOTE: The best way to prevent vise jaw damage to short screws while working on them is to use a thin piece of scrap wood, drill a hole slightly undersize, and self-tap the screw. You can then work the protruding shank on the other side with a file (Figures 40 and 41).

BARREL TENONS

The barrel has been dovetailed for the two barrel tenons, which you'll need to work a bit in order to make them fit properly. When removing metal from these parts, you'll need to pay special attention to two areas for fit. The first is the bottom surface of the tenon's dovetail itself, of course; but the other area that is easy to overlook is the bottom of the blade where it will slide against the barrel's outer surface. If you don't watch both of these areas as you remove metal from the tenon, you can easily take too much from the bottom of the tenon's dovetail and still not be able to drift the part into the slot because there's too much metal on the bottom of the blade.

With the barrel oriented bottom-side-up and the muzzle away from you, fit the parts from right to left. In order to eliminate vibration, be sure the barrel is held firmly in a vise with the padded jaws holding the area you'll be working. Choose whichever end of the tenon looks narrower, and

mark that side (Figure 42). Lightly sand the bottom of the tenon while trying the fit often. A good technique is to staple a length of 150-grit sandpaper rough side up onto your bench. Grasp the tenon by the blade, and using a figure eight motion, which will help avoid taking material off unevenly, begin sanding the metal on only the bottom of the tenon (Figure 43).

When the part slides into the dovetail a bit, use your ½ in. wood dowel as a drift, holding it only against the base of the tenon. Do not hammer the tenon directly. When the tenon slides about one-third of the way into the dovetail with normal tapping, you've removed about all you'll need to. As previously mentioned, watch the bottom of the blade to see that it doesn't hang up on the flat of the barrel. If it does, lightly file the underside of the blade until it clears. When you're sure there's enough clearance, drift the tenon the rest of the way into the slot. You want a good, tight fit that will stay that way for the life of the rifle. If the bottom of the blade is against the barrel, so much the better (Figure 44).

The two barrel tenon pins will be used to hold the forestock wood to the barrel. You'll need to drill a hole from one side of the stock, through the barrel tenon, and then on out the other side in a single operation.

Lay the barrel bottom-side-up on a flat surface. Using a small rule and a Sharpie®, as shown in Figure 45, make a vertical mark on the barrel at the mid-point of the tenon. Very carefully measure the distance from the top of the barrel (surface of the bench) to the vertical center of the tenon. You'll use these measurements to mark the stock for the proper spot to drill.

The stock's barrel channel has been inlet precisely at the factory, so the barrel should drop right in. As you assemble and disassemble the barrel and stock, you may find that the fit is so close that it will "air lock" in place, making removal difficult. A simple way to deal with this without damaging the fragile forestock is to use a wood dowel inserted into the bore, place a length of ***soft*** wood against the top of the barrel flat, and tap lightly to separate the parts (Figure 46).

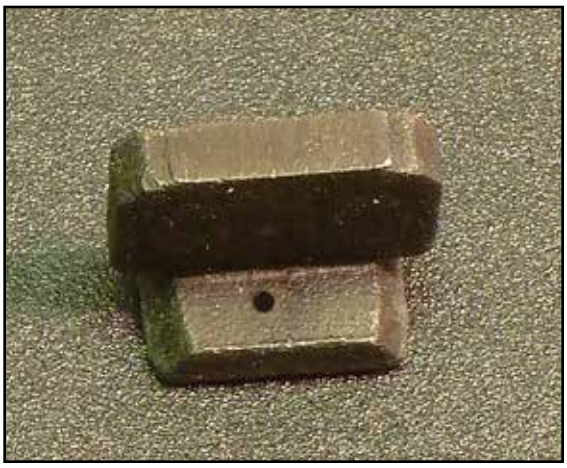

Figure 42: Mark the end of the tenon's base, which appears to be the most narrow.

Figure 43: Work the tenon against the abrasive, rather than the other way around.

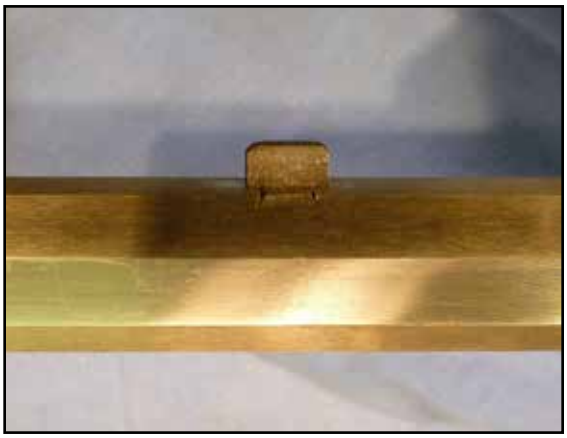

Figure 44: Use a drift to install the tenon into its dovetail, tapping against the base. Do not tap the blade.

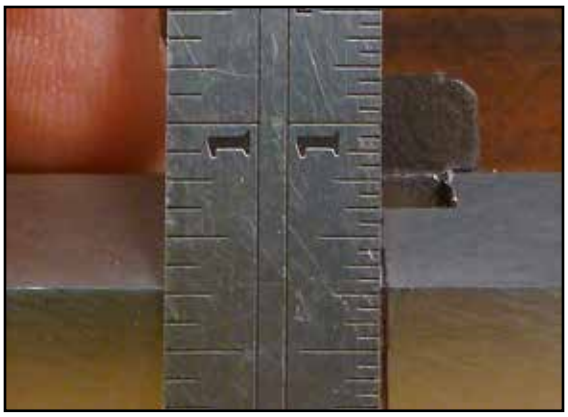

Figure 45: Carefully measure from the top of the inverted barrel to the center of the tenon.

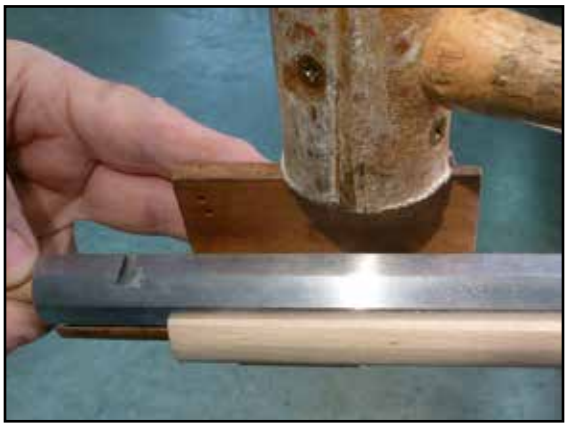

Figure 46: Hold the barrel with a ½ in. dowel inserted into the bore, and tap the stock lightly.

Now place the barrel into the stock and ensure it is ALL THE WAY into the wood, making sure it is seated all the way back into its inlet at the rear, as well. Clamp or tape it to be sure it stays seated. Lay it on the flat surface once again, belly side up. Using the witness mark you made on the barrel and the measurement you took for the center of the tenon, mark the stock for drilling (Figure 47). Again, use a center punch to mark your starting point.

To avoid splitting or chipping the stock, put a piece of tape on the wood where the drill bit will exit. Select a drill bit as close to the pin size as possible, but if not exact, then smaller than the pin. Using the two-person method again, carefully drill horizontally through the stock and tenon and on out the other side (Figure 48).

Remove the barrel from the stock and try to fit the pin through the tenon. If the hole is too small, use a slightly larger bit or a needle file to enlarge the hole slightly, but try not to enlarge the hole any bigger than the pin. The reason for working on only the hole in the tenon is that once we know the pin will pass through the metal, it will be relatively easy to compress the wood to accommodate the pin, ensuring that it will remain where it belongs without drifting out. Do not use wax to aid in the installation of the pins, as it can cause problems in the finishing stage.

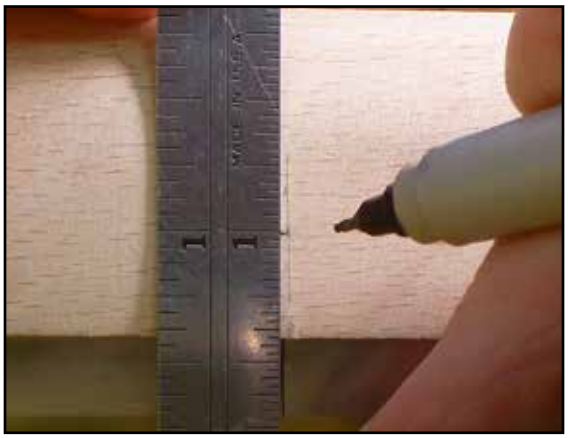

Figure 47: Seat the barrel into the stock, clamp it, and make a witness mark before drilling.

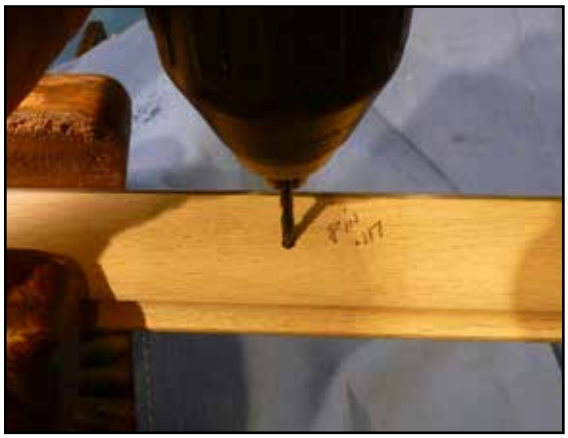

Figure 48: Carefully drill all the way through.

FRONT THIMBLE

The front thimble has been factory drilled and tapped during manufacture, so will be simple to install. Find the approximate midpoint between the stock tenon pin and the edge of the nose cap's inlet to mark the location for drilling the hole for the ramrod thimble screw (Figure 49). Find the center of the barrel channel flat, mark it, and drill the hole in the wood only, for a slip fit of the screw (Figure 50), and then countersink.

Now that the tenons, pins, and thimbles are properly fit, go ahead and assemble the barrel and stock.

Figure 49: Locate the thimble where you think it looks best.

Figure 50: Mark the center of the barrel channel, drill, and countersink.

Refer to the supplementary instructions from Traditions in order to proceed with the trigger adjustment.

TRIGGER ASSEMBLY

Next to be fit is the trigger assembly. Familiarize yourself with the functions of the triggers, and how they interact. You'll need a good understanding of how everything works together in order to do the final fitting and function testing. Using transfer black, inlet the assembly down into its proper place. You'll need to get it only deep enough at the front to be even with the level of the wood that has been inlet at the factory (Figure 51). You'll need to remove the wood at the rear of the trigger assembly that is around the back of the rear spring and its screw (Figure 52). When the rear of the trigger plate bottoms into its factory-cut inlet, the inletting of the trigger assembly is complete.

Now it's time to test the function of the lock and trigger as they work together. At this point, you will need to refer to the additional resources and view the assembly instructions from Traditions. Do not adjust the functions of the trigger assembly, as they are properly set at the factory. Any problems you encounter will likely be a matter of needing to properly inlet the parts in relation to each other. You'll likely find that the lock parts that previously moved freely will now need a bit more attention, as assembling all the parts into the stock where they can interact has possibly moved them a tiny bit into their proper places. Apply a bit of transfer black to any moving parts, assemble them, and try the lock for function. Then remove it, leaving the trigger assembly and barrel in place. NOTE: If the lock screws are too long, (Figure 53), the rear screw will possibly engage the left side of the hammer, preventing proper movement. Ensure

Figure 52: Inlet the indicated area until the trigger plate drops into its factory inlet.

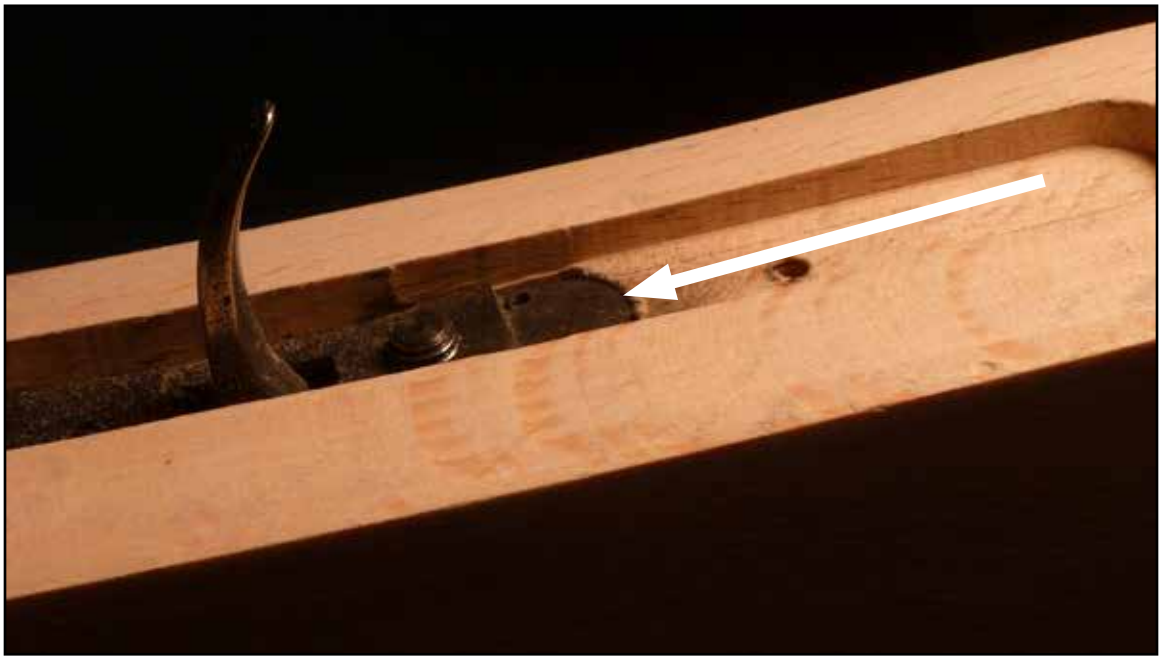

Figure 51: Inlet the trigger assembly just deep enough so that the wood is level with the bottom of the assembly.

Figure 53: If the rear lock screw is too long, shorten it to clear moving parts.

that the brass washer is in place under the head of the lock screw, and if the screw is still too long, just shorten it to clear any moving parts. When you've gotten everything working properly, remove the lock assembly one more time to ensure that there are no areas of transfer black indicating pressure points that will interfere with proper function.

TRIGGER GUARD

Begin the process of inletting the brass trigger guard assembly by checking the fit of the front of the part into its precut inlet. If it needs some final fitting, you can remove either a bit of brass or wood. By this point in the process, you've gained enough experience to use your judgment. Once the front of the assembly is properly fit into its inlet, coat the rear tang of the guard with inletting black and begin to inlet (Figure 54). ***Do not try to bend the brass! If you break it, replacement parts are not available!*** Be very careful to cut straight down and do not undercut as you deepen the inlet, because if you do, it will result in an unsightly gap when the surface of the wood is worked down to the level of the brass. Again, if you choose to remove brass instead of wood, that's okay.

You'll need to keep an eye on areas other than the ones that you've been inletting, as is shown in Figure 55. You don't want pressure in the wrong places, so in the case illustrated here, you'd just file away a bit of the brass until there's clearance.

SHAPE THE BACK HALF OF THE STOCK

The stock has been rough-shaped at the factory leaving .030 in. – .050 in. or more extra wood on the outside. The reason for this is that since wood is organic and can move a bit after it leaves the profiler, as it responds to changes in humidity and continues to cure, it is better to have a little extra to work with than having .030 in. too little.

Figure 54: Begin to inlet the rear tang of the trigger guard; do not bend the brass.

Figure 55: Watch for problem areas as you proceed.

Shaping, as well as sanding, shows our stockmaking skills, or the lack thereof. Flats should be flat, rounded surfaces should be just that, and edges should be crisp. One place where you'll need to exercise caution will be where wood meets metal, such as the juncture of buttstock and buttplate. Care must be taken to maintain the flat surface at the edge. Another place where you'll need to take care is where the rounded surface meets a flat, such as the toe line or trigger guard.

Start with the heel area (top) of the buttstock. You'll have more control if you start your strokes at the edge where you know you'll want to work the wood down, and feather the pressure on the file as it approaches the nose of the comb (Figure 56). This way you can keep an eye on your progress, and won't be so likely to round the edge as you finish your file stroke, as would be the case if you started at the comb nose and worked back toward the butt. If you were to use

Figure 56: Starting at the heel of the buttstock, shape with long file strokes.

Figure 57:Work the sides the same way.

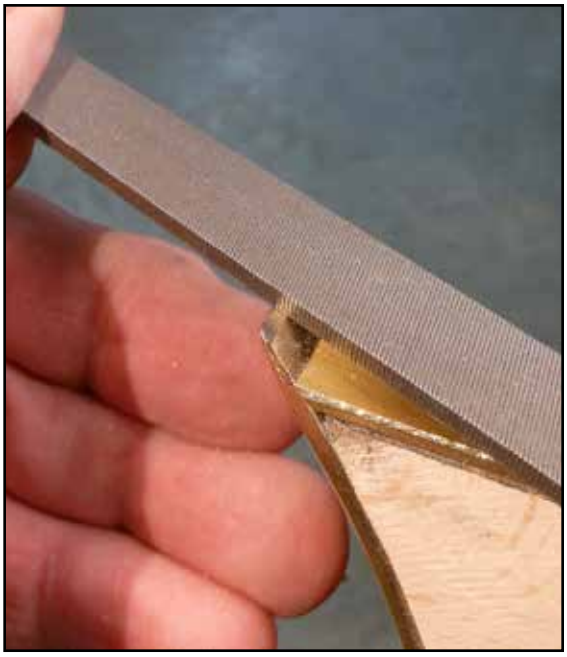

Figure 58: File the excess brass from the toe area of the buttplate.

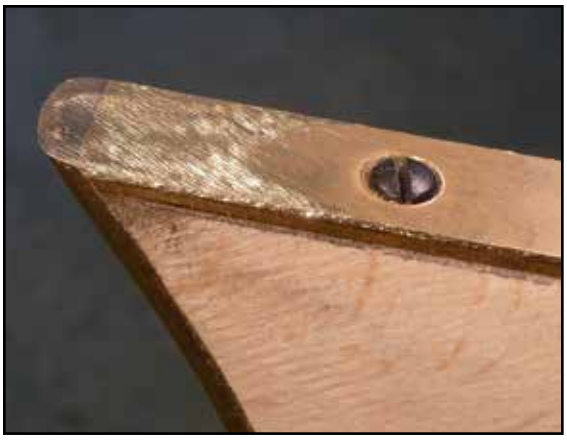

Figure 59: File until the surfaces match.

Figure 60: Using abrasives from 150-grit to 320-grit, polish the surface of the brass using a flat sanding block. Remember to alter the direction of your sanding strokes with each grit used.

short crosswise strokes, you'd end up with dips in the surface. Using long file strokes will save you a lot of work later on during the final shaping/sanding process.

Next file the sides of the buttstock down using the same long filing strokes (Figure 57). You need only to take the wood down to almost the level of the buttplate. There's no need to file down completely to brass, as any scratches you put into the metal will just mean more work later when you polish.

Now we'll deal with the toe area where the point of the buttplate extends beyond the toeplate. You'll file the excess down as illustrated in Figures 58 and 59, until the metal is all the same level. Then you'll use cloth abrasive strips to even out and polish the surface, starting with 150-grit. Since the surface you're working with is flat, use a file for backing, and polish the metal with all strokes going the same direction. When you can see no scratches other than the ones you're making, switch to the next finer grit with strokes going at right angles to the ones you first used (Figure 60).

As previously mentioned, alternating directions with each finer grit is the proper way to polish metal. With each finer grit, you'll change directions until you've gotten the metal to the shine you're looking for. Always use a flat backing when working on flat surfaces. There is no need to proceed beyond 320-grit.

The reason a backing or sanding block is always used on flat surfaces is that if you were to sand with just fingertip pressure, you'd create uneven surfaces that would show in the finished product, particularly if the metal or wood is finished to a high shine. In addition, blocks are necessary to preserve sharp edge detail. Sanding blocks can be made of hard rubber, hockey pucks, art gum erasers, short lengths of vacuum hose purchased from an auto parts store, dowels — anything your imagination can come up with.

Go over all areas of the stock, removing excess wood where it stands above the metal, and blending areas as seamlessly as you can. Moving to the flat on the underside of the stock, to the area at the rear of the trigger guard, file the wood down to almost the level of the guard, going as far forward as the shape permits, trying to keep a straight line between the toeplate and trigger guard (Figure 61). Work the tang at the front of the guard the same way. Then remove the guard and trigger assembly from the stock and blend the wood that's in between the areas you've worked until the line flows from front to back. You can work with both the file and 120-grit

Figure 61: Remember, flats should be flat, rounded areas round, and edges crisp.

Figure 62: Remove the trigger guard assembly and sand the area to create a smooth surface.

Figure 64: Now file around the breech area.

Figure 63: Work the flats around the trigger guard, ensuring a uniform job.

Figure 65: Bring the hammer to full-cock position, reshape the wood, and sand with a round sanding block.

sandpaper (always with a sanding block of some kind) as you blend the surfaces (Figure 62).

When you get that surface shaped the way you want it, file and sand the sides where they meet the bottom line that you've just worked so that all the flats surrounding the trigger guard inlets are uniform, or at least flow (Figure 63). Repeat these steps on the sides where they join the flat portion of the toe line between the rear of the trigger guard and the toeplate.

Going to the top of the stock, file the excess wood away above the breech area, being careful not to scratch the metal (Figure 64). Now blend the flat area you've created into the slope of the wood.

Bring the hammer to full-cock position and mark the wood along the back of the hammer, copying the angle. Use your small gouge to shape the wood to a more pleasing angle, as shown in Figure 65. Here's an area where you can apply a little artistic expression, carving the line however it suits you, straight or curved. Use 120-grit sandpaper and a round sanding block of some kind to blend and smooth the new contours.

NOSE CAP

We've saved the installation of the nose cap and screws until now because of the frequent installation and removal of the stock and barrel required for fitting the other parts. Since the brass screws are small, haven't a lot of threaded shank, and are screwed into wood, they won't hold up to a lot of installation and removal.

Mark a line through the center of the nose cap with a Sharpie. Use a punch to mark a starting point for the drill, and then drill the brass for a slip-fit of the shank of the nose cap screws. Making sure the nose cap is anchored solidly in a vise, clamped end-wise, very carefully countersink the heads with an oversize drill for a fit that will be close to flush. Run the drill slowly if possible, as the bit can tend to grab and bury itself.

Install the nose cap on the stock; it should require little or no inletting. Using the two holes as guides, mark the wood with a punch for drilling (Figure 66). Since you're tapping into wood only, it will be a simple matter to self-thread the screws into the undersized holes you've drilled (Figure 67).

Figure 66: Center punch the drilling location of the nose cap.

Figure 67: Self thread the screws after your drilling operation is complete.

If you are very careful, you can gently chuck each screw into a drill, and spin the head against sandpaper to reshape it.

SHAPE THE FRONT OF THE STOCK

Now that the nose cap is in place, look closely at the margins of the wood flats that run alongside the top of the stock, checking for any difference in width (Figure 68). Chances are very good that one side will have a bit extra wood. Starting with the side having the narrowest flat, start the file at the juncture of nose cap and stock to remove extra wood toward the top line of the forend (Figure 69). Try to blend the width from the narrow point at the nose cap back to where the side of the stock at the top line won't need any narrowing.

Using your double-cut file, take long strokes down the length of the margin. Do this with the barrel installed, and be very careful not to scratch the metal. A couple of layers of electrical tape on the exposed portion of the barrel will help. Remember to keep rounded surfaces round, and flat ones flat. It's pretty easy to end up with the rounded sides of the forend filed flat if you aren't careful.

When you're satisfied with the shape, go to the other side and file there until the two sides match (Figure 70).

If you wish to remove wood to match the contours of the nose cap on the underside of the stock, the choice is yours to make. While it may look better if the wood is thinned, the stock will be more fragile at the end. In addition, the thimble will lose some or all of its support.

SANDING

Start the sanding with 120-grit garnet paper backed with sanding blocks. Remember: flats should be flat, and round areas should be round. Edges crisp. Begin at the butt and sand with

Figure 68: Inspect the wood flat margins for side-to-side match.

Figure 69: Starting on the thin side, blend and shape the wood from front to back.

Figure 70: Now file the opposite side to match.

Figure 71: Remove the buttplate and begin sanding.

Figure 73: Always use a sanding block.

Figure 72: Be sure to preserve detail between flat and round areas.

the grain, again using long strokes (Figure 71). Remove the brass but be careful to not get carried away and sand the wood down below the surface of the brass. Sand the top, sides, and toe area of the buttstock, blending the planes as they round, and preserving the edges (Figures 72 and 73). The use of the sanding block will help to preserve the lines that extend from the toeplate to the trigger guard. Preservation of details is one of the hallmarks of good gunstocking.

Use your round sanding blocks to sand the curved areas around the wrist and lock area (Figure 74). As you move forward toward the forestock with the flat sanding block, be sure to keep the strokes

Figure 74: Use a round sanding block around the grip and lock area.

Figure 75: Long sanding strokes will prevent a wavy appearance when finish is applied.

long in order to minimize waviness (Figure 75). Use the same techniques as you did on the buttstock. Again, remove the brass parts first, but take care to not sand below the level of the brass at any places where edges meet.

When you've completed the sanding, disassemble the stock and barrel, and all other furniture and fittings. Raise the grain by wiping a damp rag over small areas of the stock and applying heat with a hair dryer (Figure 76).

Now go to 180-grit garnet paper and completely sand the stock a final time.

The last step will be to remove all the inletting black possible. Carefully scrape it away, taking care not to open up gaps in the inletting. If it isn't all cleaned off, the sealing oil may dilute it, become stained, and run in streaks.

Now look everything over. With so much handling of the stock during all the previous steps, you may very well have put some dents into the wood. The way to deal with that is to use steam to raise them (Figure 77). Use an iron on the highest setting, soak a cotton ball in cold water, lay it over the dent and press the tip, with pressure, against the cotton ball. Repeat however many times it takes to get the wood back up to where it belongs. Re-sand the area with 180-grit to blend, and you're ready to stain and/or seal.

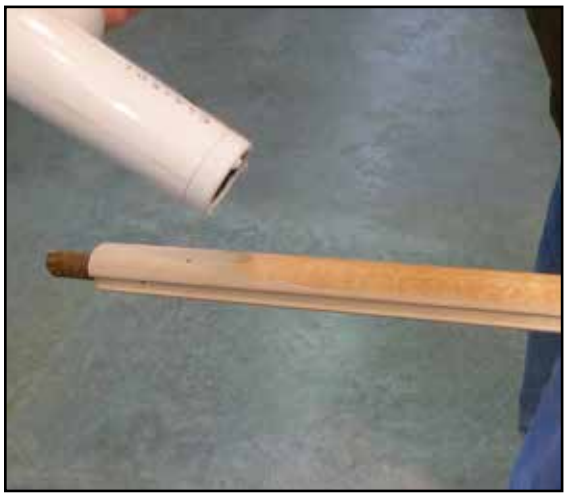

Figure 76: Raise the grain with a damp rag and heat.

Figure 77: Use steam to raise dents.

WHICH STAIN TO USE?

There are two possible approaches to staining.

The first is to stain the wood before sealing and/or finishing. Water-based stains are meant to be used on bare wood, but can raise the grain. So, if you choose to use them, be sure you've raised the grain after your last sanding, and sand one more time, using the same grit. The sealer and finish are applied after staining.

The other approach is to seal the wood first, and then use an alcohol-based stain (also called spirit stain), which will penetrate the sealer. Because of the alcohol base, grain raising is not an issue. The finish is applied after the staining.

It is up to you to decide which stain to use. Either method will produce satisfactory results as long as you follow directions on the label.

For illustration purposes, we'll seal first, and then stain with an alcohol-based stain.

SEAL THE WOOD

Gunstock wood that has been properly sealed becomes much more resistant to changes in humidity and wet weather. Sealing is also the first step in filling the pores. We've chosen to use the sealing finish, pictured in Figure 78, for several reasons.

The first reason we're using it is that it is fairly thin to begin with, and we'll make it even better by diluting it with 10% – 20% mineral spirits. The thinner allows the finish to penetrate the wood to a much greater depth. Don't be misled by the label, which states it is a clear gloss hand-rubbing finish. The label is correct, but we're using it for a different purpose.

The second reason we've chosen it is that we know it is compatible with the final finish we'll be using, as they're both made by the same company, and we've checked the labels to ensure they contain the same ingredients: tung oil and urethane. When using different products to seal and finish, as we are, if they aren't chemically compatible, the sealer may reject the finish, causing it to blister.

We'll brush on the sealer for as long as the wood will keep soaking it in (Figures 79 and 80). The process is messy. Apply the sealer to all the inlets as well, letting it flow into every bit of the stock. Keep going over it with more sealer. To give you an idea of the amount of sealer required in this first application, the 3 oz. Dixie® cup in Figure 78 was filled twice with the 90/10 mixture of sealer/mineral spirits, and all of it was used. Some ran off, but most of it soaked in.

Figure 78: Use diluted finishing oil to seal the wood.

Figure 79: Apply sealer to the entire stock until it will take no more.

Figure 80: Using an acid brush to apply the sealer over the entire surface.

Figure 81: Q-Tips® work well for soaking up excess finish puddled in the inlets.

Give it 15 minutes or so to penetrate, then wipe the entire stock down with paper towels or clean rags. Pay particular attention to any areas where the finish puddles or forms drips (Figure 81). If excess sealer or finish is allowed to dry in the inlets, you'll have difficulty fitting the parts back together during final assembly.

Allow this first coat to dry 24 hours, and then seal it again. This time the finish won't soak in as readily as it did the first time, so expect to use only about 2 oz. of the diluted sealer. Again, allow it to set for 15 minutes or so, and then wipe it down. This time the finish will puddle and drip worse than it did before, so pay particular attention to those places.

APPLY THE STAIN

Follow the directions on the label of whichever stain you choose. Saturate a cloth pad, and wipe with the grain. It will look as though the stain is uneven, as when still wet it will have a richer color than when it begins to dry and soak in (Figure 82). When it has dried superficially, look it over, and then touch up places where it seems lighter. Let it dry an hour or two, and if it still looks too light, go over it again until you get the shade you want. Let it sit at least overnight before applying any finish.

Figure 82: Choose a suitable stain of your preference, apply in increments between 2–4 hours, and let dry overnight.

Figure 83: Polish the brass starting with 320, then 400.

Figure 84: Use needle files for the tight places, as before.

POLISH THE BRASS

The brass parts will need to be finished to a brushed appearance, meaning you'll only need to polish to 320- or 400-grit. If you were to proceed to 600-grit or finer, the resulting shine will be less forgiving of small scratches/imperfections on the surface.

You'll need two sheets of wet/dry sandpaper, one of 320-grit and one of 400. You'll find that there will be less waste if the pieces are cut into 2 in. squares (Figures 83 and 84).

Proceed as you did with the initial brass preparation, polishing first one direction, and then going the opposite direction with the next finer grit (Figure 85).

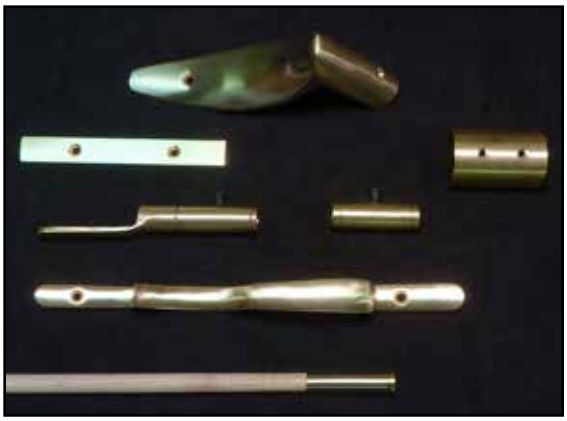

Figure 85: Now all pieces are displayed with a brushed finish.

APPLY THE STOCK FINISH

The Gun-Sav'r® Pro Custom Oil finish we'll be using is available in either Gloss or Hunter Satin (Figure 86). The Gloss is a good choice, but requires a bit of experience to learn to control, while the Hunter Satin is more forgiving and gives good results even if you've never used it before. As mentioned previously, it is a urethane/oil finish, and as such it is the best choice for outdoor use. The old-fashioned linseed oil finishes were beautiful, but passed water like a sponge. The urethane/oil finishes are beautiful and do a very good job of repelling moisture as well.

The label states it is run-resistant, and it is. While it is the best we've found in this regard, it is not run-proof. The label suggests you spray to a "just wet" stage, but since there is a very fine line between "just wet" and "too wet," it is better to not go that far. One of the best attributes of the Hunter Satin finish is that you can apply a very light-medium coating, let it set up, then come back with another light coat, and the coats will blend perfectly. It won't be apparent at first, but as it begins to dry to a satin appearance all areas will take on the same glow. Subsequent coats will blend just as well, so there is no reason to invite disaster by getting in a hurry and creating runs. Spray with long, even strokes, much the same as when working with the files or sandpaper.

Don't apply too many coats in any one day, as the process seems to benefit from a good overnight drying. Just keep adding coats until all is smooth and even.

Unless you have a spraying booth, you'll likely have some areas with particles in the finish that don't belong there.

Let the stock dry for several days. By then the finish will have cured sufficiently so that you can use an abrasive pad in the finest grit you can find to level the finish in just those areas. Don't remove the finish; just level it. Probably the finest grit pads you'll be able to find will be 320-grit or so, but if you keep a light touch, you won't break through the stock finish while leveling it (Figures 87 and 88). Go over the entire stock with the blending pad, even in areas that already look good. If available, compressed air and/or a tack rag like those used in body shops will ensure there are no particles left on the surface or in the inlets.

Figure 86: Gun-Sav'r Pro Custom Oil, a great choice for gunstock finishes.

Figure 87: Let the finish dry and cure before completing a light sanding with a sanding pad.

Figure 88: Soft foam-backed sanding pads work well for flattening the finish prior to the final coat.

Steel wool is not recommended because in the manufacturing process it is treated with oil, which is not compatible with the oil we're using. There is oil-free steel wool available through fine woodworking supply dealers, but stay away from the regular kind sold in hardware stores.

Now a very light spraying will finish the job.

We've not illustrated the finishing process for a couple of reasons. First, airborne finish isn't good for the camera equipment, and second, the finishing process requires our total concentration.

SIGHTS

We'll fit the sights tentatively at this stage, as we don't want to take the chance of marring the barrel after the browning process. They'll need to be fit the same as you did with the barrel tenons. File or sand the bottom of the base until the part begins to slide into the dovetail cut (Figure 89). Again, continue to work the metal down until the part slides roughly one-third of the way into its slot. Be sure to fit the rear sight with the facet shown in Figure 90 toward the rear. Work both the front and rear sights down to the same stage of completion, and set them aside. Resist the temptation to file or smooth the brass blade of the front sight, as that should be saved for the sighting-in process.

Figure 89: Sand and/or file the sights much like the process with the barrel tenons.

Figure 90: Drift the sights into the dovetail.

Muzzle Crowning

The shape of the muzzle is critical for the accuracy and precision of any firearm. Because the muzzle is the last part of the firearm to touch the projectile, its concentricity is key. When the bullet leaves the muzzle, the high pressure gasses pushing against it will still act upon it in the open atmosphere. If the muzzle shape is damaged or not concentric, it will direct the gas unevenly around the bullet, forcing it off of its intended course. A concentric muzzle will distribute the exiting gasses evenly around the bullet, causing little to no disruption in trajectory.

There are different shapes of muzzle crowns, each with their own benefits, though the concentricity of the crown is more important. The most popular muzzle shapes are flat, round, and 11°. A flat crown is exactly what its name implies: flat. The flat crown is perfectly 90° perpendicular to the bore, with a slight 45° bevel at the bore. The round crown is also appropriately named because the muzzle shape is rounded.

The 11° or "target" crown has gained a lot of popularity as a precision muzzle crown. The 11° crown consists of an 11° bevel, perpendicular

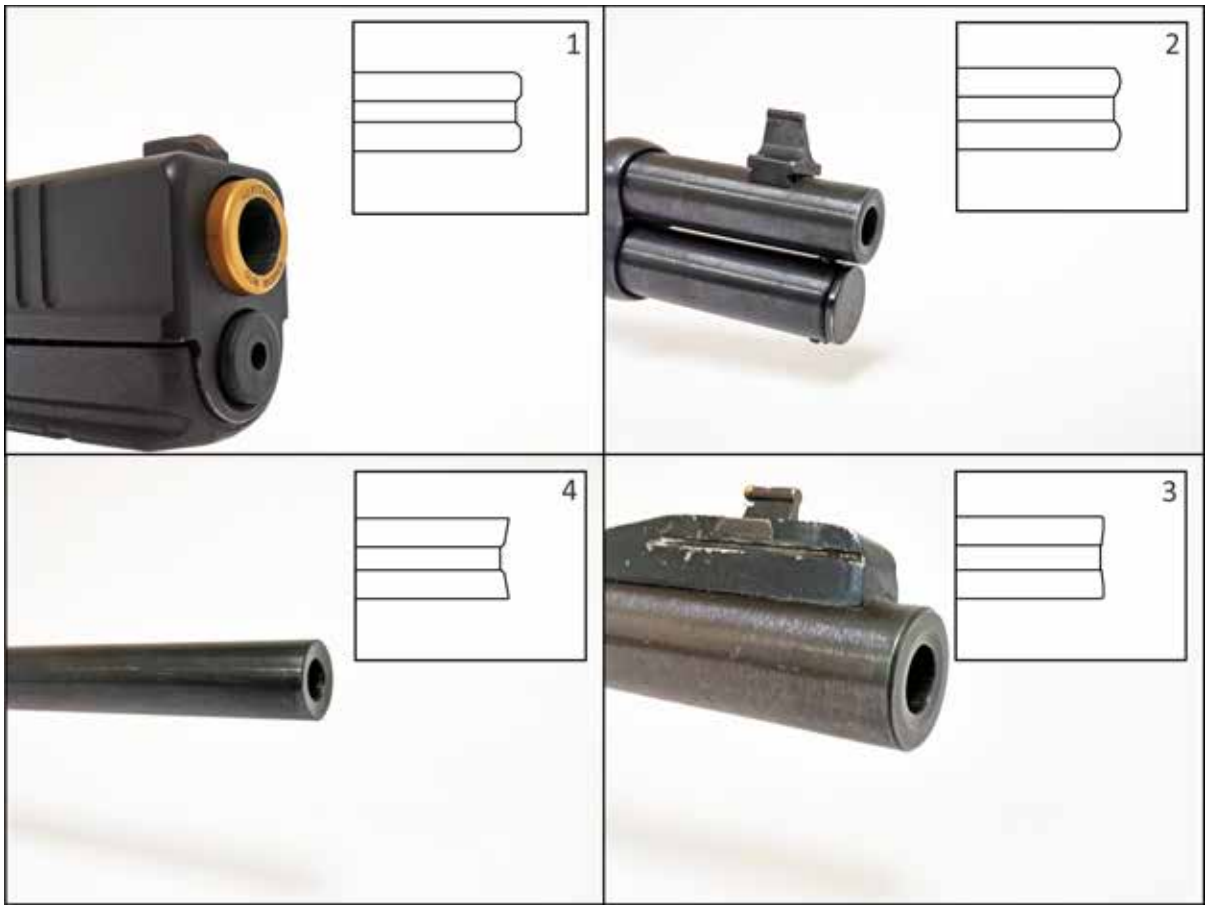

Figure 91: Different muzzle shapes: 1. Flat crown with beveled bore. 2. Round or "hunter's" crown. 3. 11° "target" crown. 4. Hybrid flat and target crown with beveled edges.

from the bore. This slight bevel is believed to be the best shape for the smoothest transition of the exiting gasses and ensures the exiting gasses do not disrupt the bullet's intended trajectory.

CUTTING AND SHAPING THE CROWN

Recutting or reshaping the muzzle of an older or damaged firearm is a fairly common occurrence for most gunsmiths. This can be accomplished in several different ways, by machine and by hand. The two cutting methods involve both machinery and cutting tools, while the reshaping methods can be done by hand with simple hand tools.

The first of the two cutting methods, the lathe turning method, is the most accurate, but involves a significant investment in tools and a fair amount of time. The lathe turning method involves the use of a lathe and a single-point cutting bit. The second method, the hand cutting method, has proven to be almost as accurate as the lathe turning method, with a very small investment in tooling and a greater amount of time. The hand cutting method involves a specialty cutter with multiple cutting surfaces on one face of the cutter. The cutter can be driven by hand or with a hand drill.

The two shaping methods are fairly similar with the only difference being the tools used

to complete the shaping. Both methods rely on a brass "lap" and abrasive lapping compound. The difference between the two is the "lap" being used. One method relies on a specialty lap that is specifically designed for shaping muzzle crowns while the other uses brass screws that are available from any hardware store. Both methods can be fairly accurate, and both are fairly cheap, but they are extremely time-consuming.

MATERIALS LISTS

The following is a list of materials you will need to complete the various types of muzzle crowning methods. The lists are separated by the materials needed for each process.

LATHE TURNING

- Lathe – including three- or four-jaw chuck
- Appropriate bits for the style of crown desired
- Dial indicator
- Caliper
- Marking dye
- Steel wool #000 – #0000
- Oil and brushes
- 45 minutes – 1 hour

Figure 92: Lathe for turning barrels.

HAND CUTTER

- Hand cutter – available online from several retailers
- Appropriately sized pilot
- Vise – with padded vise jaws
- Cutting fluid and brushes
- Optional hand drill
- Optional shank attachment for hand drill
- Optional T-handle – for cutting by hand
- Steel wool #000 – #0000
- 1 – 1.5 hours

Figure 93: Crown hand cutter.

BRASS LAP

- Brass lap – available online from several sources, including Brownells
- 600-grit lapping compound
- Hand drill
- Vise – with padded vise jaws
- Cleaning solvent
- 1 – 2 hours

Figure 94: Brass lap.

BRASS SCREW

- Brass screw – round head machine screw, ⅜ in. – 16 x 1 ¼ in. available online from most hardware stores
- 600-grit lapping compound
- Hand drill
- Cleaning solvent
- 1 – 2 hours

Figure 95: Brass screws.

Forming the Crown

The following is a basic outline for forming the muzzle crown. Over time you will develop a method that works best for you. The processes are in order from the most involved to the least involved.

LATHE TURNING

The lathe turning process is the most involved process because it involves the greatest investment of tooling. However, this investment is returned in time and accuracy. The turning method produces the most concentric crown in the least amount of time. The procedure for cutting a crown on a lathe is as follows:

- **Safety** – The lathe is a very powerful machine that can easily injure you if you fail to follow basic safety rules. Always wear eye protection and appropriate attire, no long sleeves, no jewelry, hair up and out of the way. Make certain both you and the machine are clear of anything that may become tangled while it is running. Also, make sure you have everything you need nearby and organized out of the way.
- **Setup** – The barrel must be centered and secured in the chuck of the lathe. Insert the barrel into the lathe with 3 in. – 4 in. of barrel sticking out from the chuck. Using a dial indicator in the bore of the barrel, turn and adjust the vise jaws until the bore is concentric with the center of the spindle and the center of its rotation.
- **Cutting** – Once the barrel is centered and secured, cutting is fairly simple. The face of the muzzle must be trued before cutting the crown. This is accomplished with a facing cutter. Once the face is trued, you can either leave it alone (flat crown) or cut a radius or bevel. You can also cut steps and recesses.
- **Finishing** – Once the desired muzzle shape is achieved, you can finish it. The purpose of finishing the crown is beyond aesthetic. Any burrs along the inside edge of the muzzle can cause disruption in the bullet's flight. Most burrs will be knocked off when the firearm is fired but will leave the edge chipped. Finishing is easily accomplished with #000 – #0000 steel wool pressed into the muzzle while the machine spins at low speed or is spun by hand. You can use a cotton swab to

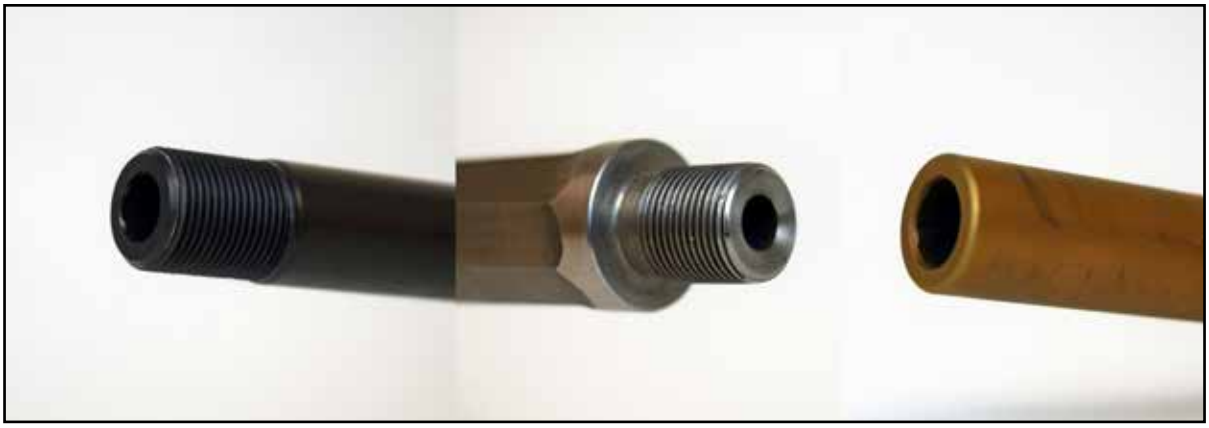

Figure 96: Muzzles crowns cut with a lathe.

test the bore for burrs. If there are any burrs, the edge will snag on the cotton swab. When the bore is free from all burrs, the cotton swab will not snag. Clean the bore with a patch to remove any excess chips or debris.

The lathe method of cutting crowns provides the greatest versatility, speed, and ease when compared to the other options. The biggest downside is the initial investment. The lathe method is capable of cutting any shape of muzzle crown with limitless variations of the standard shapes.

HAND CUTTING

The hand cutting process is far less involved than the lathe turning process. The investment in tooling is miniscule when compared to the lathe process (a couple hundred dollars vs. several thousand). The results that can be achieved are almost on par with the lathe method. The procedure for cutting a crown by hand is as follows:

- **Safety** – Although an electric hand drill is nowhere near as powerful as a lathe, it has its own inherent dangers. Always wear eye protection and appropriate attire, no long sleeves, no jewelry, hair up and out of the way. Make certain both you and the drill are clear of anything that may become tangled while it is running. Also make sure you have everything you need nearby and organized out of the way.

Figure 97: Cutter setup.

- **Setup** – Start by securing the barrel in the vise. The barrel can be held vertically (with the muzzle pointing up) or horizontally (with the muzzle sideways); the setup is up to you. The most important thing is that you are comfortable and can hold the drill steady and straight in line with the bore. Attach the shank to the cutter and insert the appropriately sized pilot (in this case the .50 caliber pilot).

Figure 98: Cutting the muzzle.

Figure 99: Finishing the muzzle.

Insert and secure the cutter in the drill. Apply cutting fluid to both the muzzle and the cutter. Insert the pilot into the bore and touch the cutter to the muzzle. Make sure the drill is set to run in the correct direction (most cutters are designed to work clockwise).

- **Cutting** – Cutting is simple and easy to mess up. The speed at which the cutter cuts will determine the outcome of the muzzle. The initial rough cut and most of the material removal can be done at a medium speed with light pressure. Remember, you can remove material but you cannot add it back, so move slowly and work cautiously. Once you feel you are close to your desired results, stop.
- **Finishing** – Finishing is done by hand with the cutter and the T-handle. Remove the cutter from the drill and remove the shank attachment from the cutter and attach the T-handle. Reinsert the cutter in the bore and turn the cutter by hand. Use oil and light to medium pressure. Go slowly and check your work often. Once you have reached your desired results, remove the cutter and place some steel wool around the pilot and insert it back in the drill, sandwiching the wool between the cutter and muzzle. Press the wool into the muzzle, making certain the cutter does not touch the muzzle. Check the muzzle with a cotton swab for any burrs. Continue until the muzzle is burr-free. Clean the bore with a patch to remove any excess chips or debris.

The hand cutting method is fairly simple to accomplish and produces a quality result with enough time and care, but one major downfall to the hand cutting system is the pilots. Because of variances in machining, the universal caliber pilots may not fit the bore precisely, especially with older firearms where the bore has begun to wear. A fix is to turn your own pilots on a lathe; but at that point, you can just cut the muzzle on the lathe. The hand cutting method is also limited in the shape that can be achieved. Typically, you can find cutters for flat and 11˚ muzzles.

Figure 100.

FLAT CROWNING

1. Determine the status of the muzzle (Figure 100). Use a machinist's square to check the squareness of the crown (Figure 101). Move the square around the circumference of the barrel to determine high and low spots.
2. Use marker or layout dye to mark the crown's high and low spots (Figure 102).
3. Place the barrel/rifle into a vise to secure it.
4. Plug the bore to prevent dust and debris from entering the barrel (Figure 103).

Figure 101.

Figure 102.

Figure 103.

Figure 104.

5. Using your mill file, remove material from the high spot on the muzzle until it is level with the low spots. Continue to work the high spots until the marking fluid has been removed from the crown evenly (Figure 104).

6. Measure the muzzle again in various locations to verify you have a (roughly) square crown. You may need to apply more marking fluid and repeat the previous step.

7. Once the crown is roughly squared, you can use sandpaper and sanding blocks to finish the crown. Apply more marking fluid to the crown so that you can see your high and low spots and reveal scratches (Figure 105).

8. Start with 60- to 100-grit sandpaper wrapped around a hard, flat block (Figure 106). Sand the muzzle with even pressure so that you do not change the angle of the crown. Sand the muzzle until all of the file marks have been removed. Verify with a square that the crown is still square. Apply more marking fluid.

Figure 105.

Figure 106.

Figure 107.

Figure 106.1

Figure 107.1.

9. Move from 100-grit up to 150, 220, 320, and 400 grits. Between each grit, verify that the crown is still square and apply more marking fluid to reveal scratches from the previous grit.

10. Finish the inside edge of the bore with 0000 steel wool to break any sharp edges and remove any burrs(Figure 106.1).

11. You can add a small bevel to the outside edge of the barrel to remove the sharp edge left behind when crowning the muzzle (Figures 107 and 107.1).

12. Clean up the muzzle and the bore with a quality gun cleaner and you are finished (Figure 108).

Figure 108.

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Lapping

The lapping process is very similar to the hand cutting process. Both use a drill, but the cutter is replaced with a lap and lapping compound. The lap can either be designed specifically for lapping or you can use brass machine screws. The procedure for lapping with a brass lap/screw is as follows:

- **Safety** – Although an electric hand drill is nowhere near as powerful as a lathe, it has its own inherent dangers. Always wear eye protection and appropriate attire, no long sleeves, no jewelry, hair up and out of the way. Make certain both you and the drill are clear of anything that may become tangled while it is running. Also, make sure you have everything you need nearby and organized out of the way.
- **Setup** – Start by securing the barrel in the vise. The barrel can be held vertically (with the muzzle pointing up) or horizontally (with the muzzle sideways); the setup is up to you. The most important thing is that you are comfortable and can hold the drill steady and straight in line with the bore. Insert the lap/screw into the drill and apply lapping compound to the lap/screw and muzzle. Touch the lap/screw to the muzzle.
- **Lapping** – Lapping is very simple. Lightly press the lap into the muzzle and turn the drill at a slow to medium speed. Check your work often. The lapping method is slow and does not remove material quickly. You may have to stop and add more lapping compound frequently. Take breaks and wipe the muzzle off to check your results. Continue until you reach your desired results.
- **Finishing** – When you are done lapping, all that is needed to do is to remove the lapping compound. Most compounds have a recommended cleaner. Use a patch on the bore to clean any residual compound that may have gotten inside.

The lapping method is very simple to accomplish and produces good results. Most round head laps are self-centering, which makes it difficult to produce a noncon-centric muzzle. The greatest downfalls to the lapping method is the limitation of shapes and time. You can typically find round and 45° laps.

Figure 109: Setting up the lap.

Figure 110: Lapping with a lap.

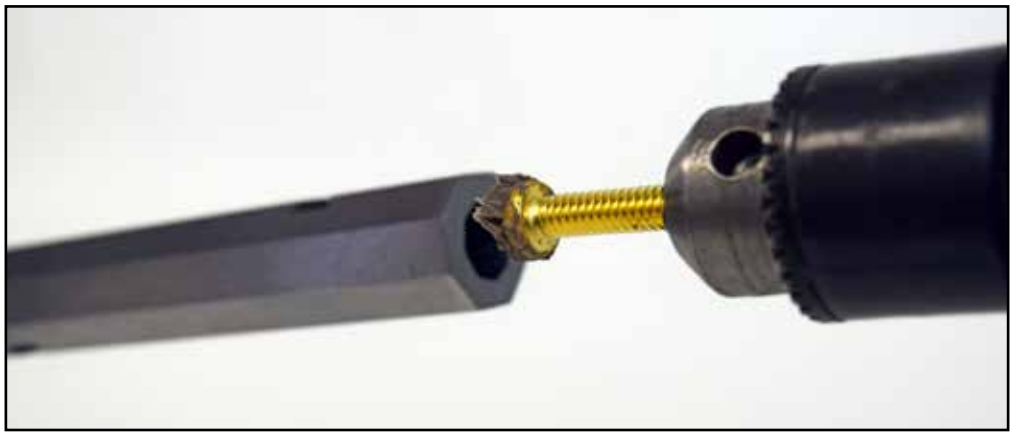

Figure 111: Lapping with a screw.

Figure 112: Finished results.

Barrel Preparation

Look your barrel over carefully for file nicks, sandpaper scratches, handling marks, or light surface rust. These areas will need to be dealt with before you proceed to the application of finish. Just use your newly acquired polishing skills on these places, giving them the same treatment as you did on the brass parts. Be sure to use a flat backing on these flat surfaces to prevent crowning.

Carefully go over the barrel flats with a fine abrasive pad. The finest available is usually 320-grit, and that is just what's called for (Figure 113). The browning and carding process will give the metal a light etch, which is about the same as a 320-polish, so there's no sense in going beyond that.

Supplies you'll need:

- A new small scrub brush
- Latex or nitrile gloves
- A spray bottle of Simple Green cleaner
- Clean cotton gloves
- A 2 ft. length of ½ in. wood dowel
- Cotton swabs
- A propane torch
- A small glass or plastic container
- Baking soda
- Paper towels
- Compressed air for drying parts (a big advantage, if available)

In the absence of tanks for bluing and rinsing, the best fix is to spend a couple of dollars on a length of 2 in. diameter PVC pipe and an end cap. When cleaning and rinsing, suspend the barrel by running a length of iron wire through the screw hole in the tang (Figure 114).

Before you begin the browning process, the barrel will need to be completely cleaned of any oil, grease, fingerprints, etc. From this point on, the barrel should not be handled with bare hands, as any oils transferred to the metal will cause problems with the finish. Using a clean brush and a solution of hot distilled water and Simple Green cleaner, scrub the metal thoroughly and then rinse again with hot water.

Insert the cleaned barrel in the PVC tube, and pour boiling distilled water to cover the metal. Wearing clean cotton gloves, dry the metal with paper towels, clean rags, or compressed air, and hang the barrel in a vertical position.

Each time you clean and rinse the barrel, you'll need to swab the bore thoroughly with a clean rag. If this step is omitted, rust will form and the bore could be ruined.

Fashion a length of ½ in. dowel to use as a combination plug and handle, ensuring that it is long enough that it won't slip out of the bore as

Figure 113: The first step in the barrel preparation is to polish the flats with a 320-grit abrasive.

Figure 114: Use a wire through the tang hole to suspend the barrel in the PVC pipe for cleaning.

you handle the barrel. You'll want to keep the browning solution out of the bore, so do not apply any to the end of the barrel at all.

THE BROWNING AND CARDING PROCESS

Pour a bit of the solution into a small container, as you don't want to contaminate the bottle (Figure 115).

The browning process is begun by heating the part, then swabbing on the browning solution, usually two or three times in each session (Figure 116). The proper temperature is suggested as 150°– 200°, but the best way to tell if it is hot enough is if the solution doesn't evaporate readily; reapply heat until it does. If it runs, heat that portion, too, until it evaporates.

A streaky coating of non-uniform, yellow-brown rust will form immediately, and you'll be tempted to think you're doing something wrong (Figure 117). You'll find that treating the barrel by thirds will be the most efficient method of application. When you've coated the entire barrel with solution, do it all one more time. Since the barrel is already hot, reaching the proper temperature will be quicker this time.

Carding is a term used to describe the process of gently removing the buildup of surface rust that is the result of the slow rust method of browning or bluing. In a well-equipped shop, a carding wheel is used for this. It is basically a wire

Figure 115: Mark Lee Express Brown #2 is the author's recommended browning solution.

Figure 116: Apply heat with a propane torch, heating and applying finish until it evaporates readily.

Figure 117: A thin film of rust will form; this is the proper procedure.

Figure 118: A carding wheel is the preferred method of removing surface rust.

Figure 119: In the absence of a carding wheel, use a synthetic steel wool pad.

wheel, but differs in that the bristles are fine, long, and softer (Figure 118). It is run at slow speed, and the surface rust is gently removed from the metal.

There are two alternatives to the carding wheel. One is oil-free steel wool, available at better woodworkers supply stores, and the other is a synthetic steel wool pad, available everywhere. We will be using the pads (Figure 119).

Let the metal cool off enough to handle. The metal finish is tough, so you don't need to worry about removing the surface scale gently (Figure 120). The cleaned metal will be uneven in color, but don't worry about that, as it will even out as you progress.

Repeat the process twice more, giving the metal two applications of browning solution each cycle. With the later coats, the rust bloom may become more difficult to remove, but if you wet your steel wool pad a bit with distilled water, it will be much easier to manage. Rinse with cold distilled water. If you want a darker, red-black color, use warmer water to rinse.

Look the barrel over carefully after the last cleaning/rinsing. If any further coatings are needed, do so. The barrel illustrated required seven coatings of solution. The photo in Figure 121 was taken after the sixth coating.

Figure 120: Use gloves and apply force during the carding process.

Figure 121: Use cold distilled water to rinse between the carding and browning process.

When you are satisfied that the process has been completed, place the barrel in the PVC tube and pour in a solution of baking soda and distilled water to neutralize the chemicals. The amount of baking soda isn't critical. Let stand for 5 minutes and rinse. If this step is omitted, the browning solution may continue to etch and pit the metal.

Now coat the metal with any good gun oil, inside and out, and let it hang for 24 hours. **Be sure the oil gets into the hard-to-reach places, such as the bore, the flash hole, and dovetails, and in and around the tenons.**

Final Assembly

Clean the barrel of all the oil you put on in the last step, again paying particular attention to those hard-to-reach places. Use your scrub brush, Simple Green, and warm tap water. Dry the metal thoroughly — here is where compressed air will be a big advantage. If you don't have compressed air available, it may be worth a trip to your local tire center, as it is very important to get it DRY, inside and out.

Before you forget, run an oily patch down the bore.

Now comes the part you've been waiting for. Assemble all the component parts, starting with the buttplate, toeplate, and the lockplate, along with its washers and screws. Be sure to include the ramrod retaining spring (Figure 122) when you install the front lockplate screw. You'll probably have to square the mortise to enable the spring to function correctly when the ramrod is inserted (Figure 123). Now install the thimbles.

It is best to install the sights now, while the barrel and stock are still separate, as you don't want to run the risk of stock damage from clamping in the vise (Figures 124 and 125).

Figure 123: You may have to square the mortise for proper spring function.

Now put the stock and the barrel together, and put the trigger assembly into place. Start the tang screw, but don't tighten it yet. At this point you're just holding things together. With the buttstock held in the padded vise jaws, tap the muzzle to ensure the barrel is seated properly into its inlet

Figure 122: Installation of the ramrod retaining spring.

Figure 124: Install front sight with a delrin-tipped or brass drift.

Figure 125: Install rear sight.

at the tang. Now clamp the barrel into place and install the pins. Be sure to use a drift for final seating so you don't mar the stock finish.

Install the screw into the rear of the trigger assembly and tighten down the tang screw. We left this for last in case the barrel needed to be shifted a bit to get the pins lined up. Install the trigger guard (Figure 126).

The muzzle cap is next. Be very careful with those tiny, soft brass screws. A light touch is called for (Figure 127).

Last to be installed are the nipple and the bolster screw (Figures 128 and 129).

We've left the cleaning rod for last because we wanted to see what the finished product would look like before we made a decision about how to stain the rod. For our example, we decided on a dark stain to contrast with the colors of the stock and barrel (Figure 130). Apply the stain, wait at least an hour, and apply sealer. It is acceptable to leave it as is, or apply spray finish.

Figure 126: Install trigger guard.

Figure 127: Install muzzle cap.

Figure 129: Install bolster screw.

Figure 128: Install nipple.

Figure 130: Staining and sealing the rod is the last step in the process of the muzzleloader build.

Figure 131: A completed muzzleloader.

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